Detection of Hydrologic Change in High Resource Streams—A Synthetic Paired Basin Approach

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Abstract

A "synthetic paired basin" technique (Hartley and Funke 2001) that combines hydrologic monitoring and watershed modeling proves to be a useful tool to detect hydrologic change in creek-draining basins undergoing urbanization. In this approach, measured stream flow following sub-basin *treatment* (a period of urbanization) is compared with flow from a *control* sub-basin over the same time period. The *control* sub-basin is the *pre-treatment* sub-basin itself as represented by a well-calibrated hydrologic model that is input with *post-treatment* meteorological data. The technique was applied to Upper Bear Creek and Evans Creek, two sub-basins of similar size in the Big Bear Creek Basin. Based on these applications, it appears that the technique is a good tool for detecting hydrologic changes in urbanizing stream basins. The utility of this tool depends on consistent, accurate, pre- and post-treatment precipitation and stream flow data, as well as a watershed model of known accuracy and bias for the flow parameters of interest.

Summary of Results

In the case of Upper Bear Creek, the method indicates significant increases in peak flows and storm volumes, and a decrease in summer base flow. Although these trends are ones commonly expected to result from urbanization, base flow loss is more extreme than would be expected from the reduced recharge capacity of the urbanized landscape. The likely cause of additional base flow decline is groundwater pumping for both in-basin consumptive use and export.

Results in Evans Creek sub-basin are indicative of similar conclusions to Upper Bear Creek with one caveat—the apparent reduction in winter storm volumes is contrary to general expectation as an outcome of urbanization. One explanation may be that the loss of winter volume results from the same cause as summer base flow reduction—additional pumping, consumptive use, and water export via sewers. These factors may lower water tables and depresses base flows year round.

Recommendations

- Storm water management and regulation needs to address both increases in peak flow magnitudes and durations as well as the loss of summer base flows in high resource streams, especially ones with threatened or endangered aquatic species.
- Water conservation and water re-use programs should be developed as part of critical habitat conservation and restoration programs.
- A detailed audit of the entire water management budget including water extraction, import, consumptive use, and export for water distribution and by sewers should be a component of stream habitat conservation and restoration planning
- King County and other jurisdictions concerned about water and aquatic resource management need to develop systems for efficient, consistent, periodic monitoring and analysis of watershed conditions such as land use and cover, drainage facilities, and stream conditions.

References

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